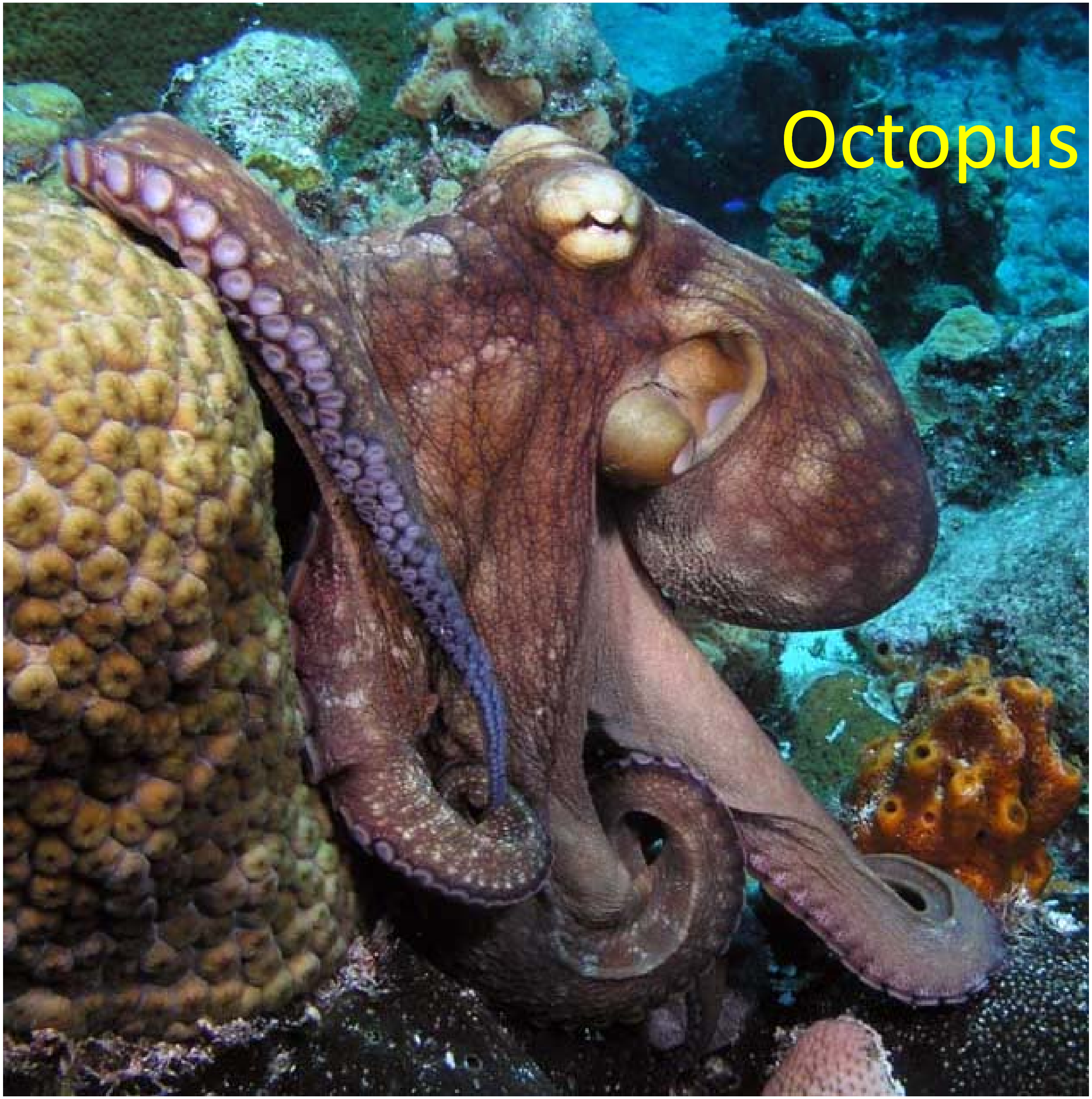
Animal Personality

Do animals have personality? (invertebrate?)


Octopus

Octopus

- Active vs. inactive
- Aggressive vs. shy
- Anxious vs. calm

Journal of Comparative Psychology
1993, Vol. 107, No. 3, 336–340

0735-7036/93/$3.00

Personalities of Octopuses (*Octopus rubescens*)

Jennifer A. Mather and Roland C. Anderson

Large individual differences are commonly found in the behavior of octopuses, even in standardized situations. *Octopus rubescens* ($n = 44$) were tested in 3 situations (alerting, threat, and feeding) to quantify this variation. A factor analysis of resulting behaviors isolated 3 orthogonal dimensions of their variability, Activity, Reactivity, and Avoidance, which accounted for 45% of the variance. The similarity of these factors to dimensions of personality in humans and individual differences in animals suggests there may be commonalities in such variation across phyla.

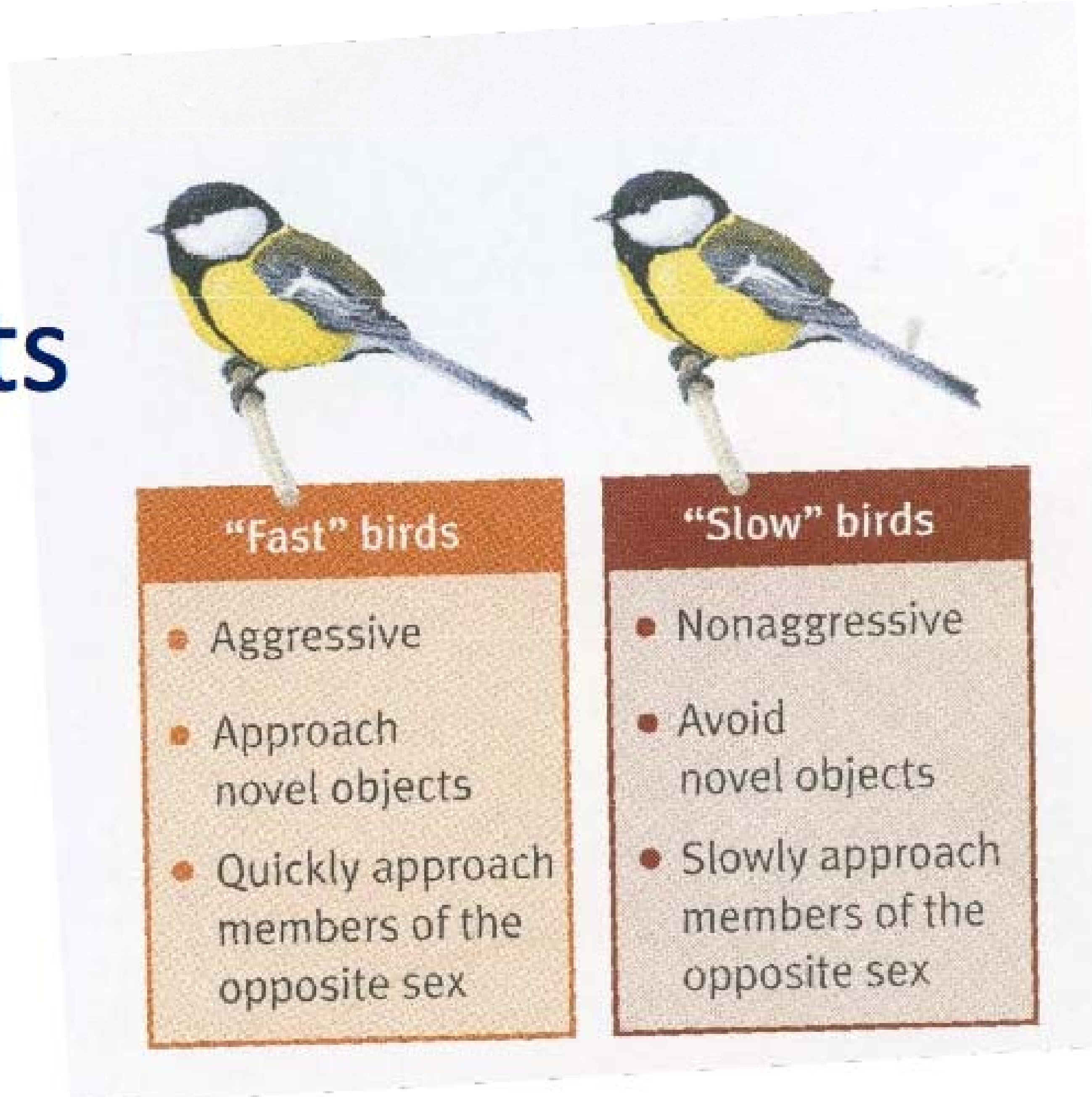
How to measure (quantify) Octopus personality?

Table 1
Measures of the Response of Individual Octopus rubescens *(n = 44) in Tests of Alerting, Threat, and Feeding*

Behavior	$M \pm SD$	Coefficient of variation	Definition
		Alerting test	
Eyes open	6.85 ± 0.66	0.10	Subject's pupils are enlarged
In den	2.08 ± 2.82	1.35	Subject stays within shelter
At rest	4.65 ± 2.37	0.51	Subject's body is low, with arms raised above head
Color change	0.38 ± 0.77	2.02	Subject's overall skin color pattern is changed
Head bob	1.73 ± 1.54	0.89	Subject makes vertical movement of the head
Move	1.10 ± 1.15	1.04	Subject changes location
Shrink	0.28 ± 0.51	1.82	Subject increases distance from observer
		Threat test	
Shrink	5.18 ± 1.67	0.40	Subject increases distance from threat
Squirt	4.15 ± 1.72	0.41	Subject jets water through funnel at threat
Crawl	1.70 ± 1.16	0.68	Subject moves on tank bottom from threat
Ink	0.08 ± 0.35	4.38	Subject releases camouflaging ink into water
In den	0.48 ± 0.96	2.00	Subject stays within shelter
Grasp	2.68 ± 2.68	1.00	Subject grasps threatening object with arms
Swim	1.65 ± 1.68	1.02	Subjects moves by jet propulsion from threat
		Feeding test	
In den	0.78 ± 1.12	1.44	Subject stays within shelter
Alert	2.48 ± 1.88	0.76	Subject raises head, with arms down
Head bob	1.40 ± 1.46	1.04	Subject makes vertical movement of the head
Capture technique[a]	2.44 ± 0.44	0.18	Subject approaches prey
Papillae change	2.36 ± 0.64	0.27	Subject raises skin surface in papillae

Great tit's personality

Great tits



"Fast" birds
Aggressive
Approach novel objects
Quickly approach members of the opposite sex
"Slow" birds
Nonaggressive
Avoid novel objects
Slowly approach members of the opposite sex

The Article you read…

Why hasn't one personality become the standard in the population?

Which personality is the best one for survival in great tits?
difference in sexes?

How do scientists test the personality of great tits?
1. individual personality test; 2. genetic study in the field



PROCEEDINGS OF THE ROYAL SOCIETY B

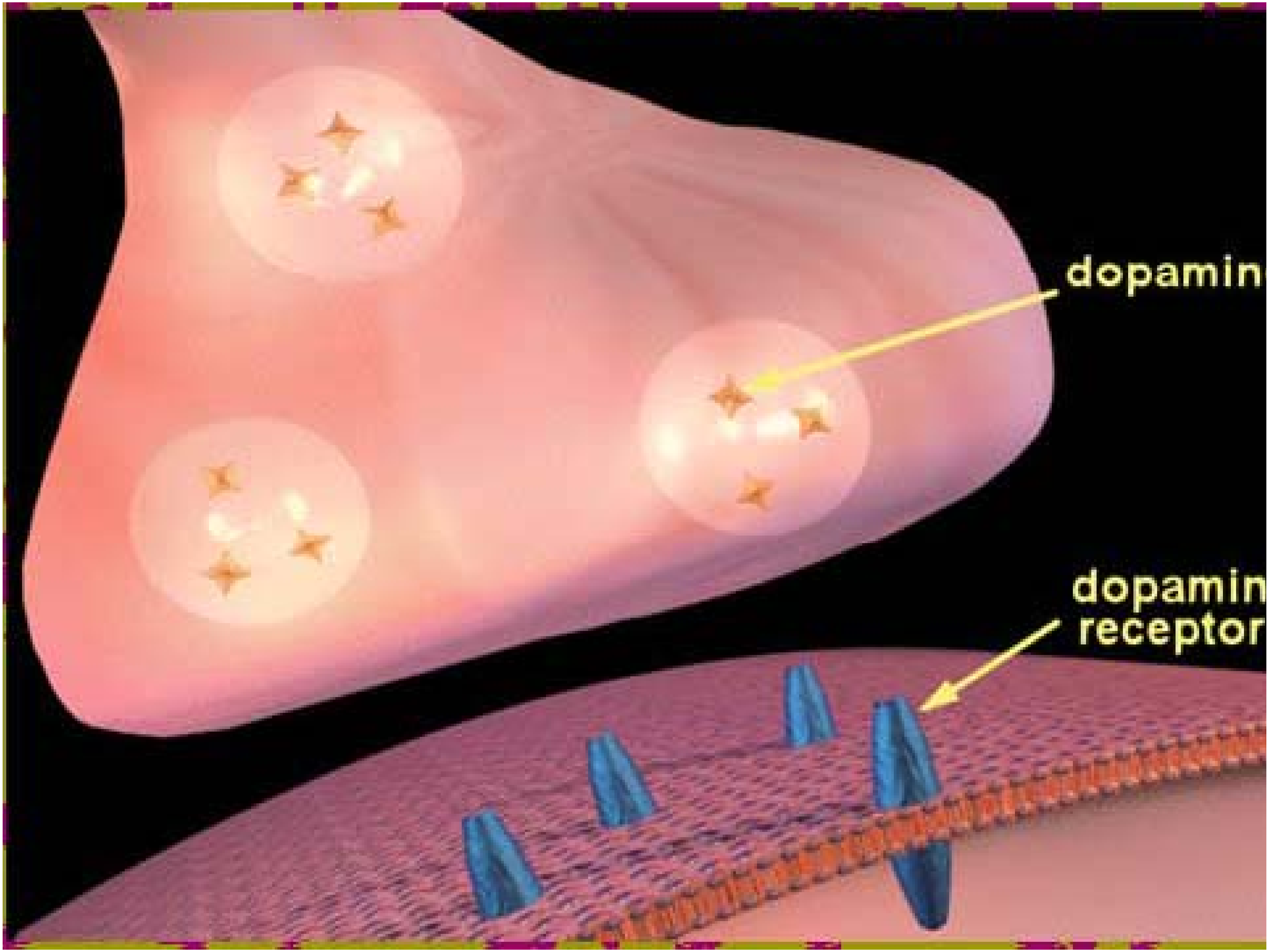
Proc. R. Soc. B (2007) 274, 1685–1691
doi:10.1098/rspb.2007.0337
Published online 1 May 2007

Drd4 gene polymorphisms are associated with personality variation in a passerine bird

Andrew E. Fidler[1,2,†], Kees van Oers[1,3,†], Piet J. Drent[3], Sylvia Kuhn[1], Jakob C. Mueller[1] and Bart Kempenaers[1,*]

[1] *Max-Planck Institute for Ornithology, PO Box 1564, 82319 Starnberg, Germany*
[2] *Cawthron Institute, Private Bag 2, Nelson 7042, New Zealand*
[3] *Netherlands Institute of Ecology, PO Box 40, 6666 ZG Heteren, The Netherlands*

Personality
Vs.
DRD4


dopamin
dopamin
receptor

Personality in great tits

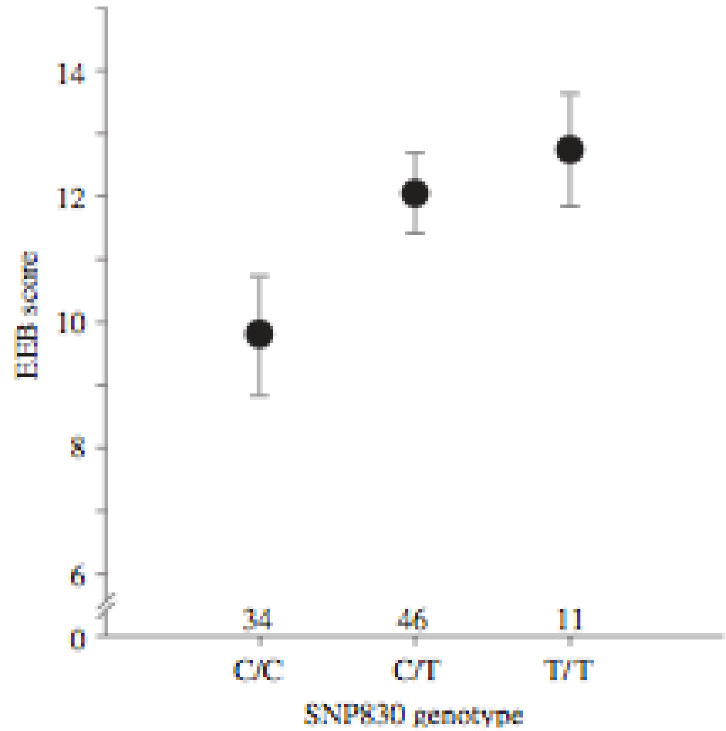
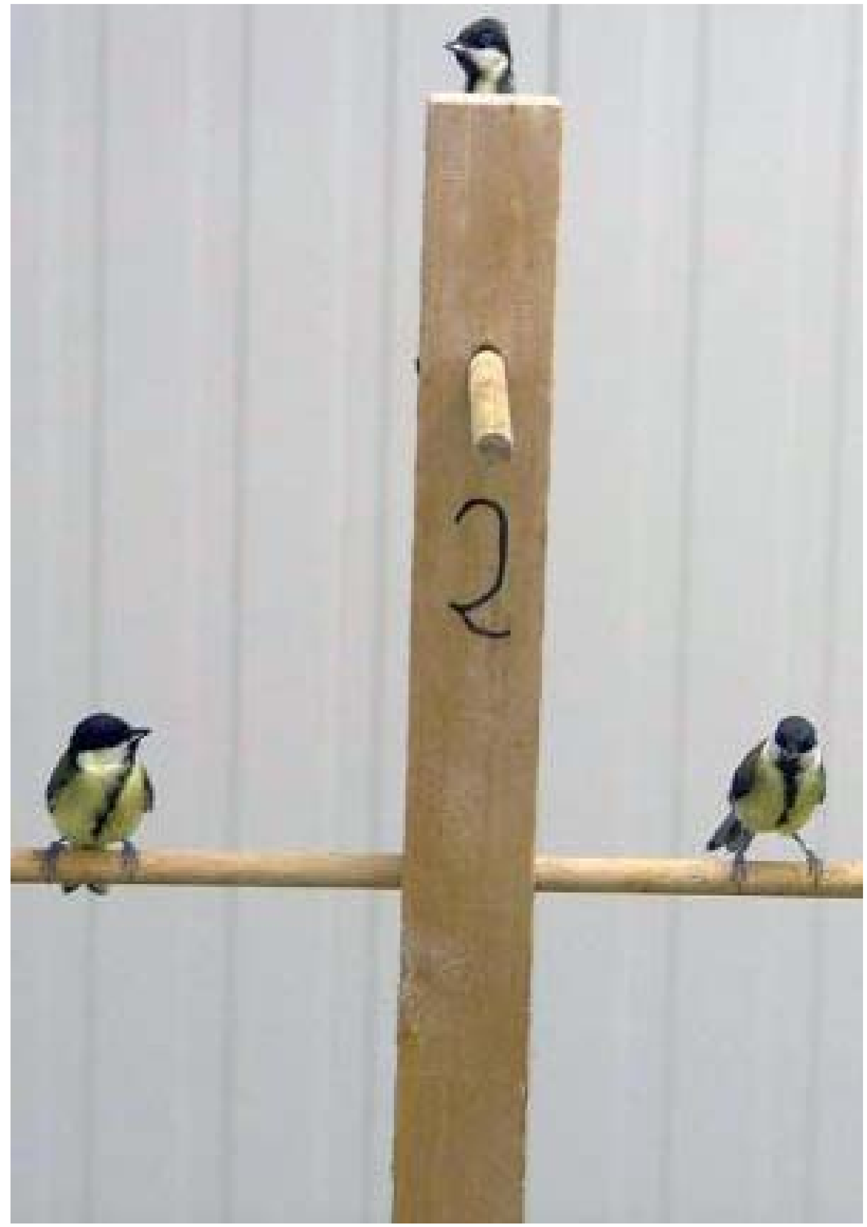


Figure 2. EEB scores of unselected birds genotyped for the *Drd4* SNP830 polymorphism. Data shown are mean EEB values ±s.e.m.; sample sizes are indicated above the *x*-axis and refer to the total number of individuals including offspring from the same brood. Note that the statistical analysis (mixed-effects models) controls for the presence of these siblings (see text for details). The most prominent difference in EEB scores is between the SNP830C/C birds and the other two genotypes, indicating a partially dominant effect of the SNP830T allele. Overall, EEB score differed significantly among SNP830 genotypes in both the effect trend model ($p = 0.038$) and the dominant effect model with SNP830T as the dominant allele ($p = 0.030$).



Personality and DRD4 variants

1. Songbirds
2. Chickens
3. Horses
4. Dogs
5. Humans

DRD4 and human personality

Association of the Dopamine D4 Receptor (*DRD4*) Gene and Approach-Related Personality Traits: Meta-Analysis and New Data

Marcus R. Munafò, Binnaz Yalcin, Saffron A. Willis-Owen, and Jonathan Flint

Background: Two variants in the dopamine D4 receptor (DRD4) gene have been reported to be associated with human approach-related traits such as novelty seeking and extraversion. However, the strength of evidence for this association remains uncertain.

Methods: We conducted a meta-analysis of published studies of the association between the DRD4 gene variable number of tandem repeats (VNTR) and C-521T polymorphisms and human approach-related personality traits, including novelty seeking, extraversion, and impulsivity, restricted to adult samples recruited from nonpsychiatric populations, and extended on this literature by attempting to confirm any evidence of association in a replication sample ($n = 309$) selected for extreme scores on the extraversion subscale of the Eysenck Personality Questionnaire from a large ($n = 40{,}090$) population-based sample.

Results: Our initial meta-analysis supported the association of the DRD4 C-521T polymorphism, but not the VNTR polymorphism, with approach-related traits. This conclusion was qualified by evidence of significant publication bias and the failure to detect association in a replication sample comprising individuals at the extremes of the trait distribution. The association of the C-521T polymorphism observed in our initial meta-analysis was robust to the inclusion of these new data, but our revised meta-analysis indicated that the association was present for measures of novelty seeking and impulsivity but not for measures of extraversion.

Conclusions: The DRD4 gene may be associated with measures of novelty seeking and impulsivity but not extraversion. The association of the C-521T variant with these measures, if genuine, may account for up to 3% of phenotypic variance.

OPEN ACCESS Freely available online PLoS one

Associations between Dopamine D4 Receptor Gene Variation with Both Infidelity and Sexual Promiscuity

Justin R. Garcia[1,2,3,4]*, James MacKillop[5,6], Edward L. Aller[1,2], Ann M. Merriwether[4,7,8], David Sloan Wilson[2,3,4], J. Koji Lum[1,2,3,4]

1 Laboratory of Evolutionary Anthropology and Health, Binghamton University, Binghamton, New York, United States of America, **2** Department of Biological Sciences, Binghamton University, Binghamton, New York, United States of America, **3** Department of Anthropology, Binghamton University, Binghamton, New York, United States of America, **4** Institute for Evolutionary Studies, Binghamton University, Binghamton, New York, United States of America, **5** Department of Psychology, University of Georgia, Athens, Georgia, United States of America, **6** Center for Alcohol and Addiction Studies, Brown University, Providence, Rhode Island, United States of America, **7** Department of Psychology, Binghamton University, Binghamton, New York, United States of America, **8** Department of Human Development, Binghamton University, Binghamton, New York, United States of America

Abstract

Background: Human sexual behavior is highly variable both within and between populations. While sex-related characteristics and sexual behavior are central to evolutionary theory (sexual selection), little is known about the genetic bases of individual variation in sexual behavior. The variable number tandem repeats (VNTR) polymorphism in exon III of the human dopamine D4 receptor gene (DRD4) has been correlated with an array of behavioral phenotypes and may be predicatively responsible for variation in motivating some sexual behaviors, particularly promiscuity and infidelity.

Methodology/Principal Findings: We administered an anonymous survey on personal history of sexual behavior and intimate relationships to 181 young adults. We also collected buccal wash samples and genotyped the DRD4 VNTR. Here we show that individuals with at least one 7-repeat allele (7R+) report a greater categorical rate of promiscuous sexual behavior (i.e., having ever had a "one-night stand") and report a more than 50% increase in instances of sexual infidelity.

Conclusions/Significance: DRD4 VNTR genotype varies considerably within and among populations and has been subject to relatively recent, local selective pressures. Individual differences in sexual behavior are likely partially mediated by individual genetic variation in genes coding for motivation and reward in the brain. Conceptualizing these findings in terms of r/K selection theory suggests a mechanism for selective pressure for and against the 7R+ genotype that may explain the considerable global allelic variation for this polymorphism.

Citation: Garcia JR, MacKillop J, Aller EL, Merriwether AM, Wilson DS, et al. (2010) Associations between Dopamine D4 Receptor Gene Variation with Both Infidelity and Sexual Promiscuity. PLoS ONE 5(11): e14162. doi:10.1371/journal.pone.0014162

Editor: Jan Lauwereyns, Kyushu University, Japan

Received October 25, 2009; **Accepted** November 4, 2010; **Published** November 30, 2010

Funding: This work was supported by Harpur College Research Awards from Binghamton University's Foundation to JRG and ELA, Binghamton University startup funds to JKL, and grants from the National Institutes of Health to JM (K23 AA016936; P30 DA027827). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

* E-mail: justin.r.garcia@gmail.com

DRD4 tandem repeat

Individual differences in DNA Repeats Polymorphism

Longer gene_ more repeats

1 aatttttgta tttttttag agacggggtt tcaccatgtt ggtcaggctg actatggagt
61 tattttaagg ttaatatata taaagggtat gatagaacac ttgtcatagt ttagaacgaa
121 ctaacgatag atagatagat agatagatag atagatagat agatagatag atagacagat
181 tgatagtttt tttttatctc actaaatagt ctatagtaaa catttaatta ccaatatttg
241 gtgcaattct gtcaatgagg ataaatgtgg aatcgttata attcttaaga atatatattc
301 cctctgagtt tttgatacct cagattttaa ggcc

Shorter gene_ less repeats

1 aatttttgta tttttttag agacggggtt tcaccatgtt ggtcaggctg actatggagt
61 tattttaagg ttaatatata taaagggtat gatagaacac ttgtcatagt ttagaacgaa
121 ctaacgatag atagatagat agatagatag atagatagat agtttttttt tatctcacta
181 aatagt ctatagtaaa catttaatta ccaatatttg gtgcaattct gtcaatgagg
241 ataaatgtgg aatcgttata attcttaaga atatatattc cctctgagtt tttgat
301 acct cagattttaa ggcc

2-11 repeats in DRD4

Among heterosexual men, those with the longer D4DR genes are 6 times more likely to have slept with a woman than those with the short gene.

Long-gened people had more sexual partners than the short-gened people.

ELSEVIER

Evolution and Human Behavior 30 (2009) 85–92

Evolution and Human Behavior

The 7R polymorphism in the dopamine receptor D_4 gene (*DRD4*) is associated with financial risk taking in men☆

Anna Dreber[a,b,1], Coren L. Apicella[c,*,1], Dan T.A. Eisenberg[d], Justin R. Garcia[e,f], Richard S. Zamore[e,f], J. Koji Lum[e,f], Benjamin Campbell[g]

[a]*Department of Economics, Stockholm School of Economics, Stockholm, Sweden*
[b]*Program for Evolutionary Dynamics, Harvard University, Cambridge, MA, USA*
[c]*Department of Anthropology, Harvard University, Cambridge, MA, USA*
[d]*Department of Anthropology, Northwestern University, Evanston, IL, USA*
[e]*Department of Anthropology, Laboratory of Evolutionary Anthropology and Health, Binghamton University, NY, USA*
[f]*Department of Biological Sciences, Binghamton University, NY, USA*
[g]*Department of Anthropology, University of Wisconsin–Milwaukee, Milwaukee, WI, USA*

Initial receipt 20 September 2008; final revision received 11 November 2008

Abstract

Individuals exhibit substantial heterogeneity in financial risk aversion. Recent work on twins demonstrated that some variation is influenced by individual heritable differences. Despite this, there has been no study investigating possible genetic loci associated with financial risk taking in healthy individuals. Here, we examined whether there is an association between financial risk preferences, elicited experimentally in a game with real monetary payoffs, and the presence of the 7-repeat allele (7R+) in the dopamine receptor D_4 gene as well as the presence of the A1 allele (A1+) in the dopamine receptor D_2 gene in 94 young men. Although we found no association between the A1 allele and risk preferences, we did find that 7R+ men are significantly more risk loving than 7R− men. This polymorphism accounts for roughly 20% of the heritable variation in financial risk taking. We suggest that selection for the 7R allele may be for a behavioral phenotype associated with risk taking. This is consistent with previous evolutionary explanations suggesting that selection for this allele was for behaviors associated with migration and male competition, both of which entail an element of risk.

Further study: 2010

DRD4 gene : political ideology ?

Political ideology is thought to be a product of social environment and historical moment, but…..

DRD4 gene : political ideology

Friendships Moderate an Association between a Dopamine Gene Variant and Political Ideology

Jaime E. Settle University of California, San Diego
Christopher T. Dawes University of California, San Diego
Nicholas A. Christakis Harvard University
James H. Fowler University of California, San Diego

Scholars in many fields have long noted the importance of social context in the development of political ideology. Recent work suggests that political ideology also has a heritable component, but no specific gene variant or combination of variants associated with political ideology have so far been identified. Here, we hypothesize that individuals with a genetic predisposition toward seeking out new experiences will tend to be more liberal, but only if they are embedded in a social context that provides them with multiple points of view. Using data from the National Longitudinal Study of Adolescent Health, we test this hypothesis by investigating an association between self-reported political ideology and the 7R variant of the dopamine receptor D4 gene (DRD4), which has previously been associated with novelty seeking. Among those with DRD4-7R, we find that the number of friendships a person has in adolescence is significantly associated with liberal political ideology. Among those without the gene variant, there is no association. This is the first study to elaborate a specific gene-environment interaction that contributes to ideological self-identification, and it highlights the importance of incorporating both nature and nurture into the study of political preferences.

The Journal of Politics, Vol. 72, No. 4, October 2010, Pp. 1189–1198 doi:10.1017/S0022381610000617
• Southern Political Science Association, 2010 ISSN 0022-3816


NEW YORK STATE
Commissioner of Motor Vehicles
ENHANCED
DRIVER LICENSE
ID: 012 345 678
CLASS D
DOCUMENT
SAMPLE, LICENSE
2345 ANYPLACE AVE
ANYTOWN NY 12345
DOB: 06-09-85
SEX: F EYES: BR HT: 5-09
E: NONE
R: NONE
ISSUED: 09-30-08 EXPIRES: 10-01-16
Sample License Document
EXCELSIOR
www.great-card.com
Genomic information
DRD4
Vassopressin
Cry2
GR
Htt …..

Personality is only partially determined by genes

Novelty seeking is 30% heritable

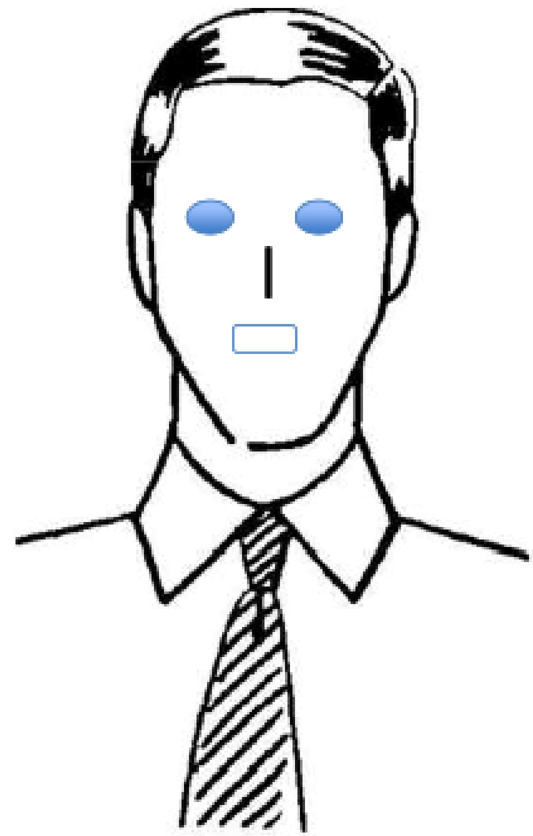
- And there are hundreds of genes associated with this novelty seeking behavior

* Environment has an important effect

Shy baby monkeys are fostered to confident mother monkey, they can outgrow their shyness
even become the leader of a group.

Personality might be related to morphological traits

Genes that are associated with a specific behavioral trait often times are also associated with other morphological or physiological traits.



Study of a European population

Shy people (study of a European population) are more likely to be blue-eyed, susceptible to allergies, tall and thin, narrow-faced, faster hearbeat.

Domestication induces changes in behavior /morphology

Wolf

Dog

How did it happen?

Domesticate /tame foxes

Silver fox

Dmitry Belyaev's domestication experiment (1959-)

Select *tamability*

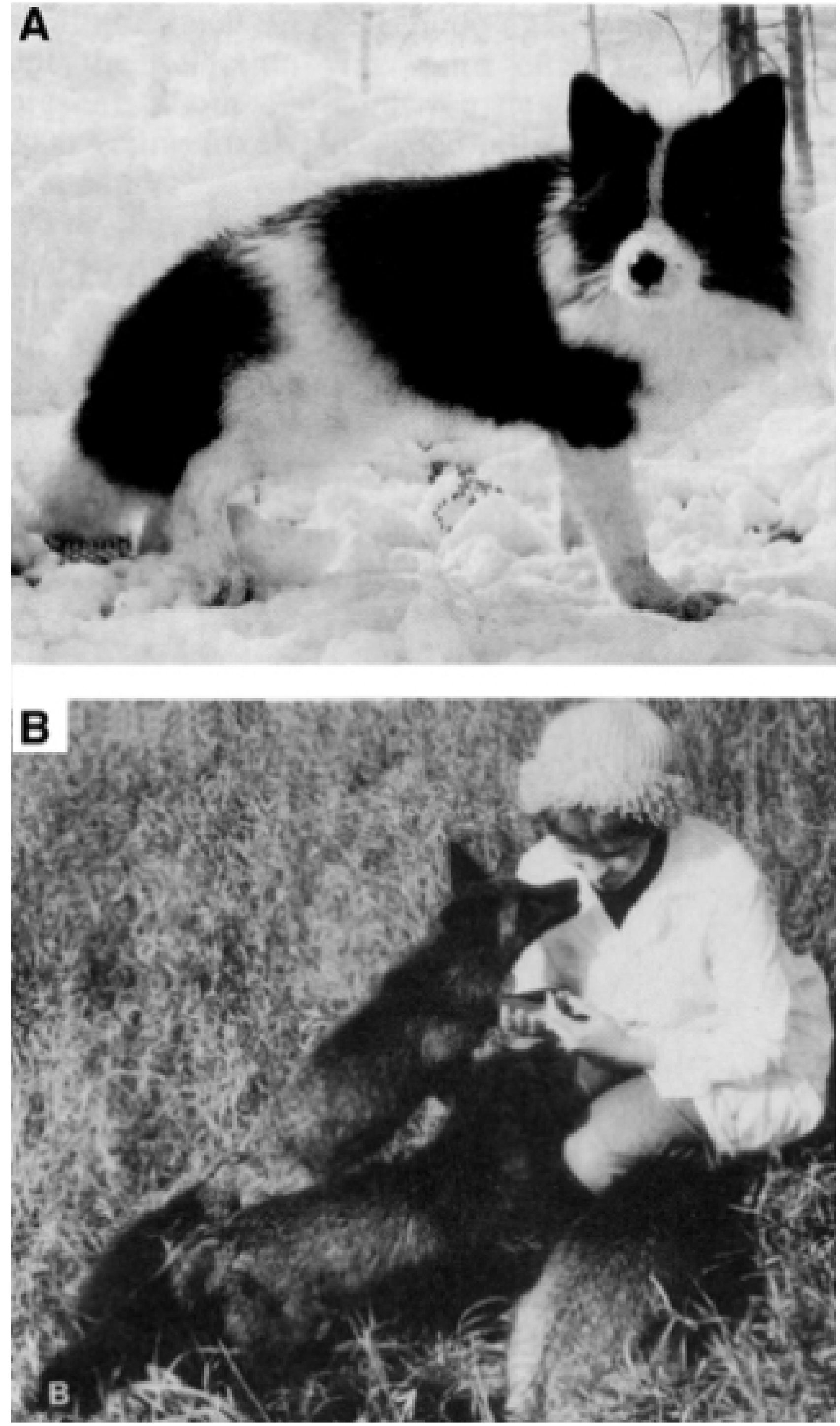
If you wished to breed a strain of fox that was tame, one way to do it would be to pick the darkest pups in the litter as the stock for breeding the next generation.

Belyaev's selective breeding program

50 years (35-40 generations)
→ 50,000 foxes

Domestic silver fox

“……as devoted as dogs but as independent as cats, capable of forming deep-rooted pair bonds with human beings.''



What have changed in the foxes over many years of selective breeding?

1. Floppy ears, curled tails
2. Patches of white fur
3. Lost musky fox smell
4. Barking, wagging tails, licking humans
5. Reduce fear response (corticosteroid)
6. Look more juvenile
7. neurotransmitter (serotonin) up
8. brain gene expression change dramatically

Current Biology Vol 15 No 22 2005

Correspondence

Selection for tameness has changed brain gene expression in silver foxes

Julia Lindberg[1*], Susanne Björnerfeldt[1*], Peter Saetre[1], Kenth Svartberg[2], Birgitte Seehuus[3], Morten Bakken[3], Carles Vilà[1] and Elena Jazin[1]

A long-term selection experiment for tameness in silver foxes offers a unique model to study transcriptome evolution associated with early canid domestication without confounding environmental effects. Our results suggest that dramatic behavioural and physiological changes caused by selection for tameness may be associated with only limited changes in brain transcriptome.

The first step in domestication of mammals was selection for tame individuals adapted to life with humans and to frequent handling. We previously reported that selection for tameness has changed brain gene expression in foxes in exactly the same farming conditions (Supplemental data).

Although selection was discontinued in the Norwegian farm and all animals were equally handled, foxes from the *S* and *NS* lines showed apparent differences in the way they reacted to human presence, and the offspring from crosses between the two lines showed intermediate behavioural responses (Figure 1). These results suggest that the differences in behaviour have an additive genetic basis.

We investigated gene expression for three brain regions in the two lines of farm foxes as well as in foxes living in the wild using cross-species hybridizations of pools of fox mRNA to human microarrays. Cross-species hybridizations are useful when the genome of the species under study is poorly known [6,7], and the method is sufficiently sensitive for identification of some genes with large expression differences [8]. In total, out of 29,750 clones investigated 3,091 showed evidence for an expression difference between wild foxes and *S* foxes, and 2,753 clones differed between wild and *NS* foxes (penalized F-ratio > 8.0, Figure 2). Most of the expression differences between the wild foxes and the two groups of farm foxes overlapped: 2,469 of the clones differed between wild foxes and both farm fox lines (8% of the investigated clones).

Contrasting with the differences to the wild foxes, the *S* and *NS* groups showed mRNA expression differences in only 40 clones (penalized F-ratio > 8.0; less than two false positives would be expected by chance alone), representing 0.1% of the clones (Supplemental Table S1). Three of these clones were verified by real-time RT-PCR (Supplemental Table S2). Each of the three brain regions separately showed a limited expression divergence between *S* and *NS*: 21.5 ± 0.39 (summed over 40 clones ± SE, $\log_2$ scale) in the amygdala; 23.5 ± 0.32 in the frontal lobe; and 23.0 ± 0.38 in the hypothalamus. Cross-species hybridization may have limited sensitivity as a result of less stringent hybridization conditions, and the method will bias the detection of expression differences towards abundant mRNA species with a conserved sequence. So, a significant proportion of the true expression differences between *NS* and *S* may have been overlooked. This, though, cannot explain the contrast of a large difference between wild and farm animals and a small difference between *S* and *NS* foxes, as the same sensitivity and bias apply to all

DNA microarrays were used to detect differential gene expression between domesticated foxes, non-domesticated foxes raised at the same farm as the tame foxes, and wild foxes.

Forty genes were found to differ (in expression) between the domesticated and non-domesticated farm-raised foxes.

About 2,700 genes differed (in expression) between the wild foxes and either set of farm-raised foxes. The authors did not analyze the functional implications of the gene expression differences they observed.

Take-home message

Behavioral traits (personality) are closely associated with other morphological or physiological traits.

Pleiotrophy: the same set of genes can affect multiple traits